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# COVID-19 and emergency department volume: The patients return but have different characteristics

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ABSTRACT

*Background:* The COVID-19 pandemic has altered behaviors in the general population, as well as processes in the healthcare industry. Patients may be afraid to pursue care in the emergency department (ED) due to perceived risk of infection. The objective of this study was to determine the impact of COVID-19 on ED metrics.
*Methods:* At one metropolitan trauma center ED, we conducted a review of all visits from February to May in 2020 and compared findings with the same months from 2019.
*Results:* A total of 34,213 ED visits occurred during the study periods (18,471 in 2019 and 15,742 in 2020), with a decline in patient visits occurring after state emergency declarations. In 2020, patients were less likely to be female and more likely to arrive by ambulance. Diagnoses in the musculoskeletal, neurologic, and genitourinary categories occurred in lower proportions in 2020; toxicology, psychiatry, and infectious diseases occurred in higher proportions. In contrast to other insurance categories, Medicare patients comprised a larger share of ED visits in 2020 compared to 2019.
*Discussion:* Despite relatively low local prevalence of COVID-19, we report decreases in ED volume for some medical diagnosis categories. A volume rebound occurred in May 2020, but did not reach 2019 levels. Public health officials should encourage local populations to seek emergency care when concerned, and could consider programs to provide transportation. Patients should continue to protect themselves with social distancing and masks.



## 1. Background

The novel coronavirus (COVID-19) has evolved into a global pandemic leading to restructuring of the U.S. economy and health care system. Social distancing guidelines put forth by the Centers for Disease Control and Prevention (CDC) in combination with travel restrictions and closure of non-essential businesses at the federal and state levels has greatly impacted the flow of everyday life. Additionally, redistribution of medical resources and cancellation of elective procedures has disrupted hospitals financially, with institutions resorting to furloughs or limited hours for employees. The culmination of these effects has led to a different landscape of patients presenting to the emergency department (ED), both in variety and volume.

On January 20, 2020 the first confirmed U.S. case of COVID-19 was diagnosed in the state of Washington [1]. By the end of January, the federal government had issued travel restrictions from China and soon placed similar restrictions on Iran and European nations as the virus continued to spread. On March 13, the pandemic was declared a national emergency in the US [2]. By late March 2020, confirmed cases and death tolls began to rise, especially in specific geographic locations such as New York City, Chicago and Seattle [3]. Many states implemented strict social distancing recommendations and lock-down policies. These included closing schools, restaurants, salons, and other non-essential businesses as well as cancelling large gatherings such as concerts and sporting events. Despite these efforts, as of June 17th the national death toll has reached 116,862 [4].

As a landlocked state with early action to limit spread, Kentucky experienced a delay in SARS-CoV-2 cases in comparison to areas of the country with higher population density. On March 6, 2020, Kentucky's first case led Governor Andy Beshear to declare a state of emergency in an effort to further mobilize resources for a unified state response [5] As of June 17, 2020, Kentucky has reported 512 deaths (population 4.468 million) [4]. Regardless of statewide incidence, the measures taken appeared to have affected patient presentation to EDs, even for serious illness [6]. In Louisville, the largest city in KY, our Level 1 Trauma center cares for a significant number of stroke and trauma patients, and most indigent patients in the metropolitan area. This study reviews the

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trends in ED patient presentations during the month prior to declaration emergencies, through the pandemic surge, and in the month of May as restrictions were lifted statewide.

## 2. Methods

We conducted a retrospective review of all patients presenting to our urban, level 1 trauma center in Louisville, Kentucky (annual ED visit volume of 57,000) from February – May in 2019, and February to May 2020. With the first confirmed US case in January 2020, and the World Health Organization declaring a global health emergency on January 31st, we chose to begin the time periods for this study on February 1 [1,2]. On March 15, Kentucky suffered its first death due to COVID-19 and by March 16 all schools in the state had ceased in-person classes [5]. On March 22, Governor Beshear ordered all non-essential businesses to close and mandated that all elective healthcare procedures end [5]. As confirmed cases and deaths continued to rise, the Kentucky state government urged individuals to stay "healthy at home" and to take advantage of expanded testing capabilities. In order to capture trends accurately, we began the study period on February 1, before any national measures had taken place. We closed the study period on May 31 to determine if any 'rebound' in ED volume had occurred. As of Saturday, May 31, Kentucky had a total of 9704 COVID-19 cases, with 431 deaths [7].

This study was approved by the Institutional Review Board. Our department documentation specialist ran an Ad Hoc report from Cerner (our EMR) using Discern Analytics software. This displayed all diagnoses provided to every ED patient during the time period. The following data were compiled for all patients meeting inclusion criteria: demographic information, insurance status, chief complaint, clinical impression / diagnosis, method of arrival, and disposition. The PI (author MH) and one medical student (AP) used the CDC National Hospital Ambulatory Medical Care Survey: Emergency Department Summary Tables [8] to code diagnoses into categories. Another attending author (AR) also reviewed the diagnoses and coded independently. The independent raters showed adequate agreement (kappa = 0.982). We eliminated duplicate category codes but allowed multiple codes for the same patient. For example, if a patient had alcohol abuse (toxicology), opioid use (toxicology), and chest pain (cardiovascular), the subject would be counted as one toxicology and one cardiovascular.

During the study period, we used the Diasorin Simplexa Direct or Cepheid GenXpert Infinity (both PCR) for COVID-19 testing, with our first test performed on March 10, and first positive in our hospital on March 28. Overall COVID-19 test results are found in the results section, with most tests occurring in April and May.

Using Microsoft Excel and IBM SPSS Statistics Version 26, we made month by month comparisons and annual comparisons. We conducted paired samples *t*-tests to determine differences in daily ED volume by each month and by year. Statistical significance was set by convention at $p < 0.05$. We reported *p* values and 95% CI. Additionally, we calculated percent change for both monthly and annual assessments to show how COVID-19 had impacted our ED metrics.

## 3. Results

A total of 34,213 ED visits occurred during the study period, with a decline in total volume by year (18,471 in 2019 and 15,742 in 2020) with month volumes of: February 2019: 4251; February 2020: 4412; March 2019: 4593; March 2020: 4440; April 2019: 4653; April 2020: 3129; May 2019: 4974; May 2020: 3761. The month of April showed the lowest volume and largest difference between the two years (decrease of 1524). Fig. 1 shows how volume changed after the state of emergency declaration and first confirmed case in the state.

For the month by month patient volume comparisons, there were no significant differences between February 2019 (mean = 151.8, SD = 15.7) and February 2020 (mean = 152.2, SD = 17.6), $p = 0.929$. Additionally, there were no significant differences between March 2019 (mean = 148.2, SD = 17.9) and March 2020 (mean = 143.2, SD = 21.4), $p = 0.375$.

We found significant differences between April 2019 and April 2020. In April 2019 the daily census average was 155.1 (SD = 14.7) and in April 2020 it was 104.3 (SD =11.9); the mean difference of 50.8 (95% CI: 43.1–58.5) was statistically significant, $p < 0.001$. Furthermore, we found differences between the May cohorts. In May 2019 the daily census averaged 160.5 (SD = 14.8) which was higher than May 2020 which had a daily census average of 121.3 (SD = 15.9); the mean difference of 39.1 (95% CI: 32.4–45.9) visits per day was statistically significant, $p < 0.001$.

In comparing the February to May 2019 months with the February to May 2020 months, we found significant differences in volume between the two years. The daily mean visits per day in the ED in 2019 was 153.9 (SD = 16.3) which was higher than 2020's daily census average of 129.9 (SD = 25.1). The mean difference between the two groups of 24 visits per day (95% CI: 18.3–29.7) was statistically significant, $p < 0.001$.

### 3.1. Demographics

We found demographic differences between the two time periods (Supplemental Table 1). The median age during the 2019 four-month period was 43 [IQR = 31–58] compared to 42 [IQR = 30–57] in 2020. There was a larger decline in percentage of visits by females than by males (−20.2% vs −10.4%). Within the two most prevalent race categories in our sample, Black/African American and White, we found no differences; in the month most impacted in terms of volume (April) there was a decrease in both groups by 33.2%. Furthermore, we found the same annual decrease with a 15% decrease in both race groups. The overall number of walk-ins/private vehicle arrival had dropped by 21.3% in 2020 (compared to 2019), this group also made up a smaller percentage of arrival modes. Notably, the biggest drop in walk-ins occurred in April 2020 with a decrease of 45.3% compared to April 2019. Only in May 2020 did the number of individuals arriving by ambulance ($N = 1815$) exceed those arriving by walk-in ($N = 1772$).

### 3.2. Diagnoses

The 34,213 patients received 52,486 different diagnoses categories. Results showed decreases in all categories between the two years (Supplemental Table 2). In terms of percent change between the two years, the largest differences were found in Dermatologic (−24.5%), Ophthalmologic (−24.1%), Genitourinary (−22.8%), Musculoskeletal (−21.9%) and Neurological (−20.8%). The diagnoses least affected were Toxicological (−2.4%), Respiratory (−3.2%), and Infectious Disease (−4.1%). Refer to Supplemental Table 2 to compare number and percentage of each diagnosis category month to month in 2020, to gauge the temporal trend in relation to statewide restrictions.

### 3.3. Dispositions and length of stay

Absolute number of hospital admissions dropped in 2020 by 10.6% and ICU admissions dropped by 3.9%, though proportion of patients admitted increased. See Supplemental Table 3 for month by month number and proportions. The percent of discharges experienced its lowest count in April 2020 (decrease in 37.9% from April 2019) and dropped by 17.5% in 2020 compared to 2019. In 2019, the median length of stay in the ED was 230 min [134–362] compared to 208 min [127–323] in 2020.

### 3.4. Insurance

We analyzed insurance category for individuals with accurate billing information ($N = 28,217$). We found decreases in individuals presenting the following types of insurance or payment information: Workers

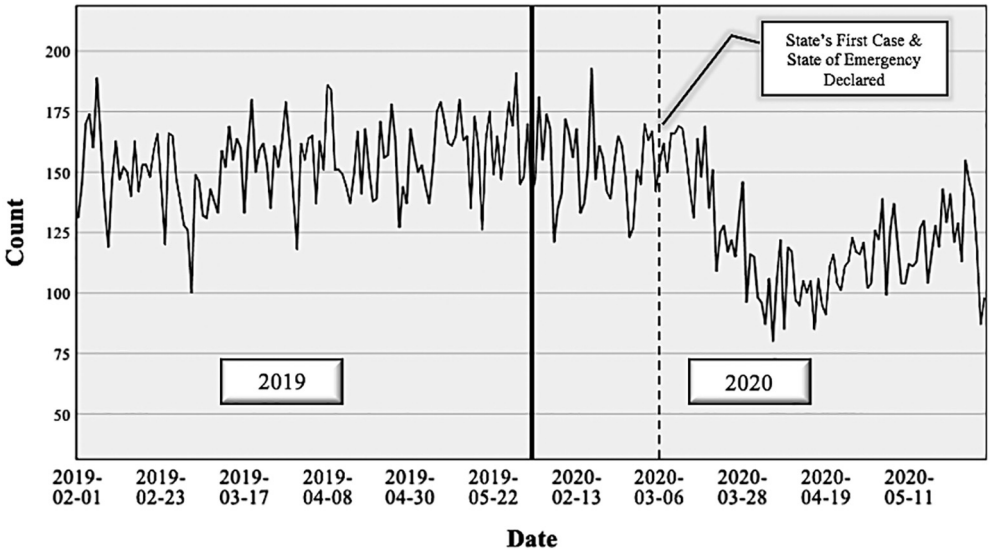


**Fig. 1.** Emergency Department Volume Changes as a Result of COVID-19. Note. The state of Kentucky has available information regarding actions taken as a result of COVID-19 which can be found here: https://governor.ky.gov/covid19

Compensation (−27%), Commercial (−15%), Self-Pay (−13%), Medicaid (−6%), and Other (−3%). In contrast, patients with Medicare comprised a larger portion of ED patients in 2020, with a 27% absolute increase in individuals with Medicare in 2020.

### *3.5. COVID-19*

Our academic hospital ED performed a total of 2063 COVID tests during the study period (19 in March, 824 in April and 1220 in May). Out of the 2063 tests, 97 (4.7%) were positive.

## 4. Discussion

Compared to 2019, our Level 1 Trauma center ED had significantly fewer patient visits just after national and state emergency declarations. Particularly low in the month of April, ED volume rebounded in May of 2020 but did not return to May 2019 overall patient volume. Less females presented to the ED in 2020 vs 2019, with a higher percentage of patients arriving by ambulance. Diagnoses in the musculoskeletal, neurologic, and genitourinary categories occurred in lower numbers in 2020. Medicare patients comprised a larger proportion of ED visits in the 2020 period compared to 2019.

While prior outbreaks of infectious diseases (Ebola, H1N1, SARS, and MERS) sparked fear, none were as widespread as the COVID-19 pandemic, causing anxiety in the general public as well as medical professionals [9,10]. With limited data, physicians must make difficult decisions regarding COVID-19 management and how to triage and care for patients with non-COVID-19 illness. While the fatality rate remains in flux, the transmissibility rate makes COVID-19 dangerous and gives it the potential to overwhelm the healthcare system. Potentially due to these concerns, patients may avoid the ED even when experiencing emergency conditions [6]. ED volumes have decreased across the US and our analysis further supports these findings. While some speculate fewer traffic accidents, workplace accidents, and traumatic injuries secondary to individuals isolating at home, no published data has verified this explanation.

The demographic differences in this population between 2019 and 2020 have no clear explanation, with fewer females and a slightly lower median age. Less patients arrived by walk in/private vehicle, suggesting patient perception of greater disease severity mandating ambulance use. Kentucky had no restrictions on driving within the state, though we do border cities in Southern Indiana, and patients may have avoided crossing state lines during this time period. A recent review of prehospital data showed an overall decrease in EMS activations, with a higher rate of death [11]. We did not find a difference in subject characteristics regarding race, other than an overall decrease in patients who identified as Asian, but with a very low count. Insurance status differed between 2019 and 2020, with less worker compensation, commercial insurance, and self-pay patients. This could be explained by less individuals actively working, as many businesses remained shut down for much of the study period. We saw a slight decrease in Medicaid percentage, and a large increase in the percentage of Medicare patients. This could be due to young, healthy patients avoiding the ED with perception of less emergent conditions. Additionally, patients with comorbidities have more risk from COVID-19 infection, thus Medicare patients may have been more likely to seek care.

As a trauma center, trauma diagnoses remained the greatest percentage of overall diagnosis categories even in 2020, though as with most categories, we saw a large drop in overall numbers in April 2020. Interestingly, after increases in March, we saw large decreases in respiratory and infectious disease diagnoses in April and May 2020 (vs 2019). Additionally, our ED had decreases in patients with cardiovascular and neurologic diagnoses in March, but even larger decreases in these two categories in April and May 2020. This matches a national concern regarding patients with possible stroke or acute myocardial infarction (MI) avoiding the ED [12]; [13]. Psychiatric diagnoses had a somewhat modest decrease in 2020 vs 2019 and had an absolute increase in March 2020 vs 2019. Toxicologic diagnoses also had only a modest overall decrease in 2020 vs 2019, and actually had increases in March and April of 2020 (vs 2019). Psychiatric and toxicologic diagnoses may have risen in March and April due to stress and anxiety experienced by the general population.

Disposition levels differed between years, with ICU admission rate lower in February and March 2020 (vs 2019) but higher in April and May 2020 (vs 2019). More patients died in the ED in 2020 compared to 2019, but the count was relatively small. We also had an overall increase in patients transferred from the ED to Emergency Psychiatry, most prominent in March and May. Of note, overall incidence of COVID-19 in our hospital system was less than 5% and estimates of incidence in the state of KY are 0.29% and in Jefferson County 0.45% [4]. Thus, relatively low risk of infection in a community can still correlate with a significant change in ED volume. During this time period, many

outpatient clinics and offices were closed, but some adopted telehealth options for patients. As testing capabilities expand and discussions surrounding reopening the economy continue, a "second wave" of COVID-19 infections may translate to changes in overall ED volume [14].

Potentially spurring a second wave of infections, lifting of restrictions in Kentucky and the US in general continue. In Kentucky, most non-essential businesses opened on May 11, and restaurants followed on May 22, albeit at limited capacities. State parks opened in early June, and amusement parks and public pools will open in late June [5]. Speculations on the months and years to come depend on imperfect mathematical models and have a range of predictions [15]; [16].

This study is limited by the single center and cross-sectional design. We attempted to mitigate the limitation of short time frame by extending data collection through the end of May 2020, as restrictions were lifted statewide. Subsequent studies should analyze large hospital network systems or state/national databases, and should include several months following COVID-19. Additionally, we did not analyze some admission variables such as reason for visit or triage scoring systems for severity of illness. Furthermore, 2020 was a leap year with an additional day of patient visits for the 2020 cohort. We decided to include all data from all months; the extra day in 2020 would only make the 2020 volume decrease more prominent. This did not affect the paired sample *t*-tests statistical comparisons, as February 29th, 2020 was not included for these.

## 5. Conclusion

This review of 34,213 visits from one trauma center compared 2019 to 2020 ED volume, illustrating temporal trends around the COVID-19 pandemic. Despite relatively low prevalence of positive COVID-19 tests in the state and city, we report significant decreases in ED volume for multiple different medical diagnosis categories. An overall rebound effect occurred in May 2020, but volume did not reach 2019 levels. Medicare patients comprised a much larger proportion of ED visits in the 2020 period compared to 2019, in contrast to all other insurance categories. Public health officials should reassure local populations that seeking care in the emergency departments remains safe, though care should be taken in making the decision to enter potentially infectious areas. Patients should continue to protect themselves in their communities, using social distancing and masks when indicated.

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## Credit author statement

ZH wrote the initial draft of the paper including portions of introduction and discussion.

JS conceptualized the idea with MH and wrote and revised sections of paper and created tables and fig.

AP recoded diagnoses in collaboration with MH.

AR and JT provided key oversight throughout the process. AR independently coded diagnoses.

MH served as PI, conceptualized the idea with JS, led the entire project and wrote key sections of paper.

## Declaration of Competing Interest

The authors report no conflicts of interest.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ajem.2020.09.009.

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